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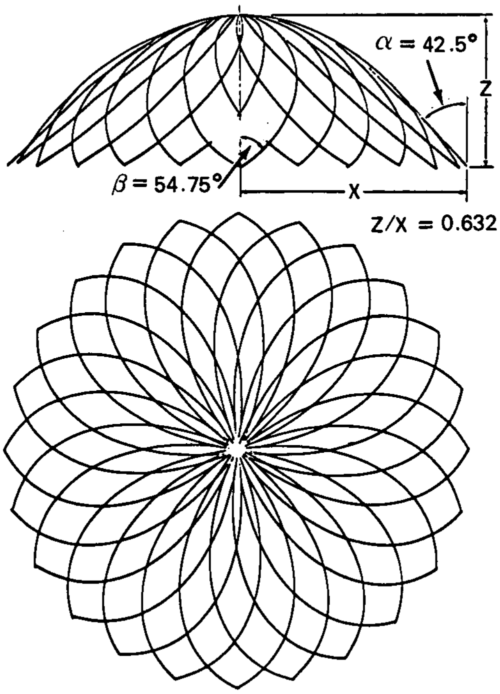
Axisymmetric and Cylindrical Isostable Structures: A Concept

A mathematical formulation, suitable for the analytical design of structural networks with uniform local stability, has yielded idealized solutions for specific two-family networks. However, much work remains to be done before idealized structures such as that shown in the figure can be reduced to practice. For example, the effects of multiple loading and of unavoidable imperfections found in real construction materials remain to be considered. Nevertheless, such configurations may eventually be used in the design of practical structures.



Axisymmetric, Gravity-Loaded Isostabiloid: Side and Top View

A structure that uses the minimum amount of material is frequently described theoretically by specifying that each structural component fail simultaneously under a unique ultimate tensile load. Examples of such structures, called "isotensoids," are uniformly stressed Maxwell-Michell networks, isotropically stressed structural "soap-film" membranes, and uniformly stressed filamentary structures.

Uniformly compressed structures analogous to the isotensoids can also be found. However, these "isocompressoids" may fail because of buckling, at a point well below their maximum compressive strength.

The referenced report is a first attempt to treat isocompressoid structures. It avoids the complex effects of general instability, matrix support, and articulate loading by constraining each element of the structure to buckle as an Euler column upon reaching its ultimate compressive load. The term "isostabiloid" is used to describe structures which satisfy this condition. The report gives particular attention to the existence of closed-dome isostabiloids, because such structures appear to have the greatest practical value.

The differential equations for the geometry of compression-loaded, two-family filamentary structures are established. The analytical formulation requires that failure due to local instability occurs simultaneously in the whole structure. Solutions such as the one illustrated are obtained for the particular case where the structure's own weight, under earth gravity, is the only load. For this case, the shape of the meridian and the cross section are determined, as well as the pattern of the filaments.

(continued overleaf)

Note:

Requests for further information may be directed to:

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No patent action is contemplated by NASA.

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